

MEMORANDUM

DATE: February 3, 2016

TO: McClure Tosch, Yakama Nation Fisheries

FROM: Elena Ramirez, L.G., RIDOLFI Inc.

SUBJECT: **Comments on Distributed Temperature Sensing for the Detection of Groundwater NW Natural GASCO Sediments Cleanup Action**

This is to provide our review comments on the document *Distributed Temperature Sensing for the Detection of Groundwater Seepage*, prepared for NW Natural by Anchor QEA and dated January 6, 2016. The document relates to the NW Natural GASCO Site in Portland Harbor and cleanup actions being undertaken at the site pursuant to an Administrative Settlement Agreement and Order on Consent with the U.S. Environmental Protection Agency.

General Comments

The NW Natural GASCO Site is located on the Willamette River and is part of the Portland Harbor Superfund Site in Portland, Oregon. The Yakama Nation strongly believes that the cleanup actions implemented at the Portland Harbor Superfund Site must be protective of the health of Tribes and other people who consume fish, and should eliminate sources of contaminants causing harm to the Columbia River and its natural resources. Ensuring long-term sediment cleanup relies heavily on adequate upland source control measures to protect the river from recontamination. The effectiveness of source control measures depends upon developing a sound understanding of complex groundwater flow, direction, and volume over the Site.

The Distributed Temperature Sensing for the Detection of Groundwater Seepage (DTS) report does not fully explain the objectives of the study or why this area was chosen for the study. This information is apparently included in the work plan but should also be included here.

Groundwater seeps are the primary transport pathway for the migration of upland subsurface contaminants to the surface water and sediments of the Willamette River. Previous investigation efforts at the Site include work using ultrasonic seepage flow meters in select areas. However, the results of the new Anchor QEA DTS report does not reference this previous work in any detail or put these new findings into the context of earlier seep meter studies, although Figure 3 of work plan for the DTS study (Anchor QEA, 2014) shows two seep meter locations in the immediate area. Groundwater seep volume estimates were made in previous work. It would be useful for this study to identify similar metrics for comparison.

River water temperature data was collected from a stilling well located on the inside of the offshore gangway of the dock, which is located approximately 750 feet downriver from the focused investigation area and at the USGS Morrison Street Bridge gauge. This location should be indicated on a smaller scale figure of the overall site (which should also include locations of other key features such as components of the hydraulic control and containment [HC&C] system). Additionally, no empirical evidence is given to demonstrate that this location is an appropriate analog of river water temperature, such as the depth and water stratification characteristics at the stilling well location compared to the focused investigation area.

An explanation of the type of data or data results appropriate for definitively identifying areas of seeps should be articulated in the report. The Phase 1 and Phase 2 data were identified as inappropriate, but it was not clear how this data did not meet data quality objectives or how the changing temperature of surface water over time impacts the ability to accurately interpret the data. Does the Phase 3 data meet the data quality measures for being appropriate for identifying areas of groundwater seeps? Where data quality objectives identified?

It appears the time used for data interpretation in Phase 3 is limited to two days. Is this adequate given the data quality objectives adequate and the site hydraulic conditions to accurately show changes in the HC&C system and for identifying statistically significant data from before and after the start of HC&C system?

Specific Comments

Executive Summary

Comment 1. Paragraph 2: Changes in groundwater seepage measured by DTS are stated to be consistent with other empirical lines of evidence and indicate that 1) groundwater potentiometric surface elevation data show groundwater gradient reversal to the extraction wells and 2) that large declines in the groundwater-specific conductance is measured in offshore piezometers. These additional lines of empirical evidence should be included with this report.

Section 1 Background

Comment 2. Paragraph 1: The report indicates that the upland hydraulic control and containment (HC&C) system is currently in full-scale operation after extensive, multi-year testing. Additional information on the system operation should be included in order to assess impact and changes relative to the groundwater seep system, and other lines of empirical evidence (specific conductance and potentiometric groundwater surface elevation data). What are the radius of influence of HC&C extraction system wells? What is the pumping rate and rate of

groundwater extraction? What is the change in groundwater flow (direction and velocity)?

Section 2.1 DTS Installation and Data Collection Summary

- Comment 3. Paragraph 1: The calibration of the DTS system prior to installation identifies that ice and warm-water baths were used. It is not clear, based on the information provided in the report, if this calibration range of temperatures is appropriate to capture the temperature ranges observed in the Willamette River and in groundwater at the Site. Is the DTS instrument response linear? Is a two-point calibration adequate for calibration prior to installation?
- Comment 4. Paragraph 3: The report indicates that surface water temperature data is collected from on-site stilling wells 750 feet downriver from the focused-investigation area and at the USGS Morrison Street gauge. Summary data of these temperatures are not presented in the report. How were data from these two locations integrated? How representative are these data compared to water temperatures within the area of the DTS array? Do both locations indicate the same variation seen over the pilot test phases periods?
- Comment 5. Paragraph 3: Groundwater temperatures were measured from piezometer PZ9-75, although a number of piezometers are included in the Figures 2 and 3. If data was available from cluster PZ7, how did it compare to PZ9? For example, how much variation was seen over the study period and did this correspond with expected variation in groundwater temperatures?

Section 3.1 Phase 1 and 2 Results

- Comment 6. Paragraph 1: The temperature differences measured during Phases 1 and 2 (3 to 7 degrees Fahrenheit in Phase 1 and 5 to 11 degrees Fahrenheit in Phase 2) appear to be large enough to assess relative differences in groundwater and surface water temperatures. It is not clear from the discussion how these conditions impacted SelkerMetrics ability to identify areas of groundwater seepage during shut down of the HC&C system during these two Phases. Why were conditions during Phase 1 and 2 not appropriate for determination of areas of groundwater seepage, even though differences in temperature ranges in Phase 3 were comparable?
- Comment 7. Paragraph 1: There is little or no discussion about the influence of the HC&C system in this report so it is not clear how the short period of HC&C system suspension during Phase 2 impacted Anchor QEA and SelkerMetrics ability to collect meaningful data to assess potential areas of groundwater seepage or recharge during this phase of the pilot test.

Section 3.2 Phase 3 Results

- Comment 8. Paragraph 1: The report indicates that six broadly distributed areas of groundwater seepage were identified based on elevated fiber optic cable temperatures relative to measured river temperatures during the period the HC&C system was suspended. These six areas should be better depicted on Figure 2. Please add information that clearly identifies the areas (size and shape) where groundwater seepage is occurring during HC&C system suspension.
- Comment 9. Paragraph 2: After the HC&C system resumed pumping, the report indicates that the groundwater-to-river temperatures differentials in the areas of interpreted groundwater seepage were reduced, reflecting groundwater gradient reversals and the infiltration of cold river water into the surface sediments. It is not clear how this data can document gradient reversals. This report does not address how groundwater seep volumes may impact the potential observed data. Is it a possibility that rather than groundwater flow reversal that temperature changes are influenced by decreases in flow rate (or lessening of the volume) of groundwater; i.e., reduced flow rather than gradient reversals?
- Comment 10. Figures 2 and 3: When comparing temperature differentials of surface water and shallow sediments between Figure 2 to Figure 3, some identified seep areas do not change in color intensity, potentially indicating that there is no change in flow direction, rate, or any indication of a gradient change. Does this suggest the possibility of groundwater seeps or movement of groundwater to shallow sediments even with the HC&C system operation? Was the duration of Phase 3 of the pilot test adequate to determine if operation of the HC&C system stopped the flow of groundwater to shallow sediments? If this was the case, should temperature differentials be cooler than the light green indicating zero, or no differential?
- Comment 11. Paragraph 3, Figures 2 and 3: On Figure 2 and Figure 3, there is an area with a high, positive differential between surface water and shallow sediments greater than 0.25 and does not change with the operation of the HC&C system. The text does not offer an explanation of this anomaly. What are the possibilities? Is this an area of groundwater seepage that is unaffected by the HC&C system? Is there additional site information that might provide information about this anomalous data?
- Comment 12. Figures 4 and 5: Please indicate the source of the river temperature data (stilling well, USGS Morrison Street Gage, or DTS fiber optic cable array [and location]).

Section 4 Challenges

Comment 13. Areas of coarse and very coarse sediment appear to impede placement of the DTS cable and this data is excluded from the DTS data evaluation. Coarser-grained sediments may present preferential flow paths within the subsurface sediments, if hydraulically linked to surface sediments. The report does not address the uncertainty of assessing potential groundwater seeps within these regions since the data was excluded from evaluation.

Section 5 Conclusions

Comment 14. The conclusion that the DTS is able to detect seepage and responses to pumping under challenging site conditions seems somewhat premature. Only one of the three phases appears successful in providing useable data and for Phase 3 only two days of data were presented. While the Phase 3 data did show some changes in conditions after the HC&C system was restarted, the changes appear difficult to quantify. It is also unclear if there is a correlation with results from previous work with the current study. It is still unclear to what degree groundwater seeps were reversed or slowed since the period of observation is very small relative to the overall pilot test period. It appears that this technology may only be appropriate to apply when weather and temperature conditions are favorable. Finally, no evidence is provided that the DTS technology can quantify seepage volumes or rates.